

OBJECTIVE FO



RCE WARRIOR

Advanced Technology Demonstration

Carol J. Fitzgerald



**"It is only by
doing things
others have not
that one can
advance."**

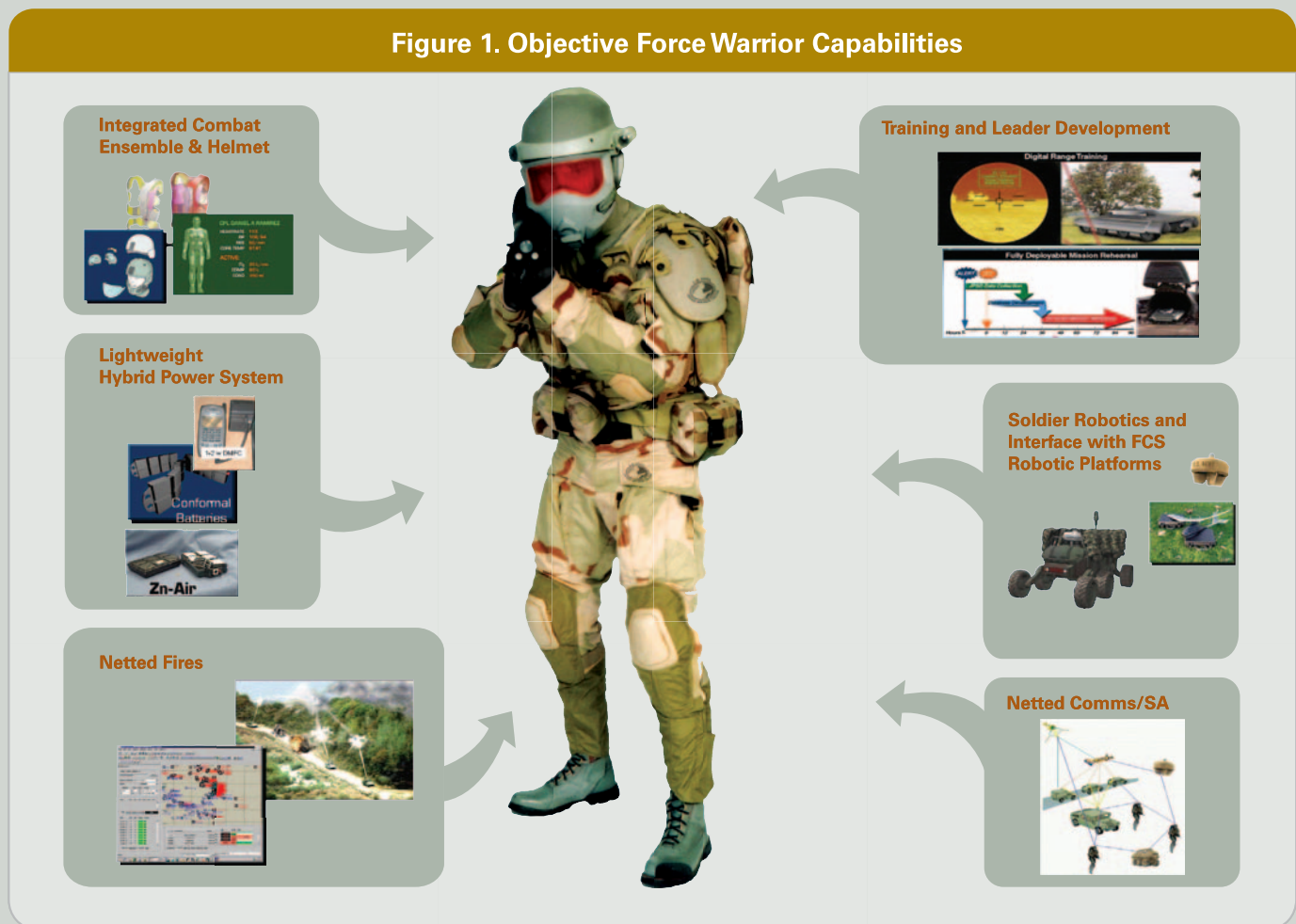
LTG George S. Patton Jr.

The Objective Force Warrior Advanced Technology Demonstration (OFW ATD), led by the U.S. Army Natick Soldier Center (NSC), is the Army's flagship science and technology (S&T) program charged with maturing and integrating technologies into a system-of-systems (SoS) and demonstrating a revolutionary capability for the individual soldier and small team. OFW is the primary S&T feeder to Land Warrior Block III Advanced Capability (LW-AC), the variant of Land Warrior that is scheduled to be fielded with the Future Combat Systems (FCS) Increment 1 in 2010. OFW is an approved FY02 Science and Technology Objective (STO) and was approved as an ATD in FY03.

The OFW vision resulted from several independent efforts sponsored by the Deputy

Assistant Secretary of the Army for Research and Technology (DASA(R&T)) to determine what could be done to field a revolutionary soldier system this decade as the centerpiece of the Army's Future Force. Among these efforts were an Independent Review Team (2000), an Army Science Board Study (2001) and a multiteam visioning effort coordinated by Oak Ridge National Laboratories. Each initiative concluded that achieving revolutionary increases in capability this decade would require increasing investments and integrating, holistic SoS approaches for the individual and small team. The result was the OFW ATD — the programmatic forcing function that will integrate myriad technology maturation efforts and demonstrate them by the end of FY06 — and a paradigm shift similar to that initiated in the FCS program.

Figure 1. Objective Force Warrior Capabilities



A Unique Approach

The early planning for OFW ATD included identification of warfighter needs, capabilities to meet those needs and investigation of technologies that could provide the desired capabilities. This resulted in many planned S&T efforts being reshaped under the leadership of DASA(R&T) and the Assistant Secretary of the Army for Acquisition, Logistics and Technology to better support the OFW vision. Planning also included active involvement with NSC by the key stakeholders — the U.S. Army Training and Doctrine Command (TRADOC) Systems Manager for the Soldier; the Project Manager Soldier and the U.S. Army Forces Command (FORSCOM). Their participation continues and is instrumental in keeping the program on the correct azimuth to accomplish the long-term OFW transition goal to Program Executive Officer Soldier for acquisition and fielding as LW-AC.

The early planning for OFW ATD included identification of warfighter needs, capabilities to meet those needs and investigation of technologies that could provide the desired capabilities.

OFW SoS

From the outset, OFW's focus has been on an SoS. This concept includes all items that the soldier wears or carries — the Soldier-Borne System (SBS) — and those systems that are integral to the small team's

assets — the Small Team Systems (STS) — that contribute greatly to mission performance. (Assets include small unmanned ground vehicles, back-packable unmanned aerial vehicles, laser designators and unattended sensors, just to name a few.) While the ATD focuses on the SoS, many technologies that are embedded within the SBS and STS components are being leveraged from STOs and other external programs like FCS for integration within or interface with the OFW SBS. This holistic TRADOC Soldier-as-a-System approach will help minimize or reduce soldier-borne loads, enhance power management and optimize individual and team performance.

Figure 2. Technologies/Capabilities

Networking Digital Radio

- Lightweight/low power SUO/SAS capability (SLICE)
- Cross-domain solution (multiple security levels)
- Electro-textile based and body conformal antennas
- Digital networking

Personal Navigation

- Hybrid all-terrain nav; 3 M, 3D accuracy
- GPS, DRM, TOA, MEMS IMU
- Kalman Filter

Situational Awareness

- Ad hoc networking
- Integration of OFW net with FCS network (WIN-T) and unattended sensor network
- Warrior team collab planning & mapping
- Horizontal data fusion
- Multiple displays (wrist-mounted, helmet-mounted, PDA) to enhance SA

Head-Borne Vision Enhancement

- Helmet mounted fused IR/I2 vision sensors
- Laser illuminator for low/no light conditions
- Improved wgt, ergonomics and ctr of gravity

Headgear Protection and Integration

- Integrated/modular design compatible w/XM50 mask for respiratory protection
- Lightweight protection for frag and 9 mm
- Integrated laser eye protection

**Direct & Area Fire Weapons**

- XM-8, XM-29, lightweight machine gun
- Lightweight 5.56 ammo

Fire Control Systems

- Laser pointer for rapid target acquisition
- Fused thermal/I2 on weapon
- Day sight for close quarters combat

Organic Supporting Fires and Synchronization

- Distributed and Integrated fire control system integrating BLOS and fires from FCS
- Software integration for near real time call for fires

Leveraged FCS Unmanned Systems

- Common operator control unit (Goal: integrated soldier control unit)

Robotic Mule

- Load carriage, power generation
- Mobile squad-based fusion station

Small Unmanned Ground Vehicle

- Modular sensor suite payloads

Organic Unmanned Aerial Vehicle

- One man portable
- 0.5 lb payload; 8(T)-16(O) km range
- Real time day/night video and comms

Figure 3. Technologies/Capabilities

Rechargeable Batteries and Chargers

- Li ion polymer - 160 Wh/kg
- FCS compatible
- Team smart recharger
- Conformal designs

Hybrid Power Sources

- High-energy density fuel cell centralized recharger 400 Wh/kg
- Metal air systems 1000 Wh/Kg
- Distributed body worn power architectures for 1-2 W DMFC modules

Power Management

- Low power processing
- Efficient SW architectures
- Automated/selective device powering

Training

- Embedded
- TTP recall; leader development
- Collaborative en route training and mission rehearsal

Human Performance

- System fightability (physical, cognitive)
- Physical/cognitive performance enhancement
- Customized voice, tactile, haptic, visual, auditory human-system interfaces
- Intelligent multi-modal input/output devices

**Integrated Combat Suit**

- Modular design
- Integrated body armor/load carriage chassis with hybrid ballistic materials
- Joint protection
- Multifunctional materials including:
 - SPM for CB/wet protection
 - Electro-textile power/data PAN
 - Novel signature mgmt (multi-environment visual and near/far IR)
 - FR materials

Thermal Balance

- Passive design features (spacer materials, highly wicking materials)

Prompt Casualty Care

- Integrated tourniquets

Sustainment

- Water generation/purification
- Nutritional supplements
- Compressed and "eat-on-the-move" rations

Physiological Status Monitoring

- Sensor suite for PSM
- Remote triage (life sign detection)

Hydration

- On-the-move hydration with CB filtration and purification

OFW Imperatives

The OFW ATD seeks to exhibit connectivity within the command, control, communications, computers, intelligence, surveillance and reconnaissance network of the unit of action (UA) and Future Force. The goal is to operate the soldier-borne system for 24 mission hours without resupply and reduce soldier-borne fighting loads to 50 pounds or less. These capabilities will be demonstrated at a system technology readiness level (TRL) 6 (system/subsystem model or prototype demonstration in a relevant environment) and in a fightable, user-friendly, tactically viable and technologically sound SoS. In addition, the requirements for LW-AC (Block III of the LW Operational Requirements Document (ORD)), currently in draft, will be refined and validated in conjunction with the spiral design process. The goal is to have the ORD completed by the end of FY06 to support Milestone B.

OFW Capabilities

Myriad capabilities are embodied within the OFW SoS concept and push the technological research and development envelope. These capabilities include netted communications and collaborative situational awareness; netted lethality, full-spectrum individual protection in an integrated multifunctional ensemble; sensory enhancement; robotics and mobility; power sources and power management; training and human performance as depicted in Figure 1. The specific technologies associated with these capabilities, which will be demonstrated in the FY06 ATD, are illustrated in Figures 2 and 3.

OFW ATD Structure

The OFW seamless government/industry team is using an Integrated Product and Process Development (IPPD) approach with disciplined systems engineering processes and a structure of teams and integrated product teams (IPTs) that reflect the holistic, human-centric, SoS approach. The OFW ATD structure has three phases:

- Phase I — Concept Development
- Phase II — Preliminary and Detailed Design
- Phase III — Prototype Fabrication and Demonstration

Phase I was competitive with two Lead Technology Integrator (LTI) teams — Eagle Enterprise and Wolfpack Enterprise — developing competing operational and SoS concepts for all soldiers in the UA. The Army selected Eagle Enterprise for Phases II and III, where funding constraints allow for the design and fabrication of only the dismounted variants of OFW, but with inclusion of the “hooks” to grow the system

for the other soldier variants when funding becomes available. The major activities were:

- Conduct operational and organizational concept studies.
- Perform technology searches and assessments.
- Design initial operational, system and software architectures.
- Perform critical modeling and simulation experiments.
- Evaluate targeted government technology maturity investments.
- Demonstrate TRL 3.

The team will conduct four design spirals during Phase II to iteratively and incrementally build and assess the OFW SoS, with appropriate risk mitigation throughout the process. The major activities will be:

- Conduct four spiral “design, prototyping, experimentation and analysis” iterations.
- Implement mature process for systems and software engineering.
- Develop interfaces with FCS, Warfighter Information Network-Tactical (WIN-T) and Comanche.
- Leverage and integrate technology from related Army and DOD S&T projects.
- Perform critical modeling and simulation, integrate design evaluations and user assessments with design spirals. Refine architectures and operational requirements.
- Evolve robust prototypes through design spirals.
- Move to TRL 5.

While the ATD focuses on the SoS, many technologies that are embedded within the SBS and STS components are being leveraged from STOs and other external programs like FCS for integration within or interface with the OFW SBS. This holistic TRADOC Soldier-as-a-System approach will help minimize or reduce soldier-borne loads, enhance power management and optimize individual and team performance.

During Phase III, the OFW team will undertake several Limited Objective Experiments (LOEs) to iteratively assess OFW’s operational and technical merit and determine if

the ATD exit criteria have been met. The capstone demonstrations will look at the entire SoS used collectively and tactically and validate the enhanced operational effectiveness. Simulation experiments will augment live experimentation. An Experimental Force (EXFOR) will be requested from FORSCOM to participate throughout the Phase II design/assessment process to conduct the LOEs and capstone demos. The major activities will be:

- Fabricate final sets of products to support Squad (+) EXFOR.
- Comprehensive training program for EXFOR.
- Conduct 6 LOEs.
- Conduct capstone demo in operationally realistic environment to achieve exit criteria.
- Move to TRL 6.
- Integrate demos with FCS, WIN-T and Comanche.
- Transition to PEO Soldier for system development and demonstration phase.

Transition Strategy

The revolutionary OFW SoS will transition to PEO, Soldier when the ATD concludes. Transition deliverables will include all OFW hardware and software; technical data and analyses; tactics, techniques and procedures and training programs of instruction; any model and instrumentation upgrades that are undertaken and new processes and methodologies developed to effectively execute the rigorous ATD. In addition, a two-pronged transition approach will allow OFW technologies or components that individually mature early (i.e., a TRL 5 or 6 now or in the next year or two) to be considered by PEO Soldier for insertion into Land Warrior-Stryker to get evolutionary improvements into the hands of soldiers quickly. At the same time, these technologies will remain a part of the OFW system architecture and will be enhanced within that architecture.

Achieving Interoperability

Interoperability within the Future Force will be accomplished via OFW active participation with PEO Soldier in the FCS Soldier System Integration IPT. This IPT will provide a forum for collaborative identification, definition, development and assessment of optimal Soldier

System/FCS interfaces, based on the soldier systems' more challenging size, weight and power constraints. In addition, an Associate Contractor Agreement will allow the Eagle Enterprise LTI to interact directly with the FCS Lead Systems Integrator. Interoperability assessments are part of Phase II and interoperability experiments are part of Phase III ATD activities.

OFW begins the paradigm shift to a soldier-centric Future Force, and the rigorous, disciplined systems approach led by NSC puts LW-AC on a glidepath to success via risk reduction and pushing the envelop in this ATD. Partnering with TRADOC ensures OFW is on the right azimuth for soldier and small-team capabilities;

and partnering with PEO Soldier ensures an effective transition from S&T to acquisition. But the vision doesn't end with OFW. Future Warrior will continue to look beyond the current S&T focus to bring the full OFW revolution to fruition.

Note: If you are unfamiliar with acronyms used in this article's figures, check the List of Acronyms at <http://asc.army.mil/pubs/alt/default.cfm>.

The OFW seamless government/industry team is using an Integrated Product and Process Development (IPPD) approach with disciplined systems engineering processes and a structure of teams and integrated product teams (IPTs) that reflect the holistic, human-centric, SoS approach.

CAROL J. FITZGERALD is the OFW Technology Program Manager. She has a B.S. from Cornell University, an M.S. in science and technology commercialization from the University of Texas-Austin and an M.S. in national resource strategy. She has completed the Defense Systems Management College's Program Management Course, the Senior Acquisition Course and is a distinguished graduate of the Industrial College of the Armed Forces.

